

Attractiveness of brown rice baits to non-target birds in harvested corn and soybean fields

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Abstract: Brown rice is used as a bait-carrier for the avicide DRC-1339 (3-chloro-4-methylaniline) when baiting blackbirds (Icteridae). In March and April 1996 and 1997, we assessed non-target granivorous bird use of rice-baited plots placed in harvested corn and soybean fields in eastern South Dakota for 168 observation hours. In both years combined, we identified 10 and 14 granivorous species in corn and soybean fields, respectively. In 1996 ($X = 0.2$, $SE = 0.04$) and 1997 ($X = 1.2$, $SE = 0.38$), total numbers of granivores min^{-1} were similar between crops ($P \geq 0.322$). In 1996, bird numbers were higher ($P = 0.069$) in rice-baited fields ($X = 0.3$, $SE = 0.07$) than in unbaited reference fields ($X = 0.1$, $SE = 0.04$). In 1997, bird numbers ($X = 1.2$, $SE = 0.38$) did not differ between treatments ($P = 0.456$). Our data show that small numbers of non-target birds visited the rice-baited plots. However, total number of different individual birds using the plots was unknown.

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Keywords: DRC-1339; granivorous birds; Icteridae; non-target risk; spring migration

1 INTRODUCTION

Sunflower is a valuable crop in North Dakota and South Dakota where collectively about 1.1 billion kg, valued at US\$243 million, were harvested in 2001.^{1,2} Expansion of production has been hampered, however, by the inability of wildlife biologists to keep blackbird (Icteridae) damage below economically acceptable levels.³ Estimates of annual direct economic losses from blackbird damage consistently exceed \$5 million.⁴

In response, the US Department of Agriculture is investigating the compound DRC-1339 (3-chloro-4-methylaniline, 3-chloro-*p*-toluidine hydrochloride) as a potential tool for managing spring-migrating blackbird populations. This research is concentrated south of the main sunflower-growing areas of North Dakota and northern South Dakota where large concentrations of blackbirds are found prior to breaking up into progressively smaller groups as they migrate to breeding areas.⁵ Reducing the size of this regional population during spring, prior to the breeding effort, might be an

effective solution for reducing blackbird damage to sunflower.⁵

DRC-1339 was first developed to control European starlings (*Sturnus vulgaris* L.) at feedlots.⁶ In the 1960s, DRC-1339-baited cracked corn was tested for baiting spring-migrating blackbird populations in South Dakota, but was determined to be ineffective.⁷ During the 1980s, DRC-1339-baited rice was successfully developed for baiting blackbirds in Louisiana to protect sprouting rice.⁸ In the following decade, DRC-1339-baited rice was used to develop baiting strategies for reducing the number of spring-migrating blackbirds in North Dakota and South Dakota.⁵ The only two quantitative studies conducted in our study area showed that non-blackbird (non-target) use of rice-baited plots in harvested corn fields was low.^{9,10} Despite intensive searches by humans and trained dogs, no non-target birds were found that had succumbed to DRC-1339.^{9,10} However, non-target bird use of rice-baited plots in soybean fields was not studied, and questions have persisted about the potential risks of using rice baits in harvested corn in eastern South Dakota.¹¹

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Acute oral toxicity tests show that there are differential toxicities of DRC-1339 dosages among bird species.¹² In the more susceptible ($LD_{50} < 20 \text{ mg kg}^{-1}$) birds (blackbirds, doves, pheasants), DRC-1339 causes irreversible kidney and heart damage leading to death 24–72 h following ingestion.¹² DRC-1339 is highly ($LD_{50} = 10\text{--}50 \text{ mg kg}^{-1}$) to moderately toxic ($LD_{50} = 51\text{--}500 \text{ mg kg}^{-1}$) to most sparrows, finches and waterfowl. However, repeated exposure to sublethal doses of DRC-1339 can result in death for resistant birds as well.¹³ DRC-1339 does not appear to affect reproduction except at levels very close to those where toxicity is expressed.^{13,14} A single DRC-1339-baited rice grain is sufficient to kill smaller susceptible birds, but larger birds, such as pheasants, might need to eat 25 treated seeds to obtain a lethal dose.¹⁵ With data showing that DRC-1339 is toxic to some non-target species of birds, it seems prudent to determine which susceptible species might be exposed to treated baits.

In the springs of 1996 and 1997, we compared non-target granivorous bird use of rice-baited plots and unbaited reference plots placed in harvested fields of corn and soybean in eastern South Dakota. Our objectives were to identify granivorous birds using the plots and quantify bird-use of rice-baited and unbaited reference plots placed in harvested corn and soybean fields. This information may be used to design blackbird baiting programs while minimizing non-target bird impacts.

2 STUDY AREA

The study area was in Brookings, Miner and Lake counties in eastern South Dakota. This area was chosen because it is considered to be the most northern region where migrating flocks of blackbirds are large enough to warrant a baiting program.⁵ Eastern South Dakota lies in the Coteau Des Prairies physiographic region in the Central Lowland province.¹⁶ The landscape is characterized by low, rolling hills and a variety of glacial till deposits; undrained lakes and small wetland basins abound. Formerly tall-grass prairie, the land now consists mainly of pasture and row crops. Shelterbelts and windbreaks divide expansive field crops and surround farmsteads and residential areas. Corn and soybean are the principal crops in eastern South Dakota, comprising 92% of the planted crops.

The long-term average temperature and precipitation during March and April in eastern South Dakota are 3.3°C and 4.6 cm, respectively.² During our 2-year study, temperatures and precipitation were below average for March and April. In 1996, the temperature averaged 0.2°C and precipitation was 1.3 cm. In 1997, the average temperature was 0.9°C and precipitation was 3.8 cm.² An intense early spring storm entered the study area on 5–6 April 1997 and was followed by record cold (–15°C) from April 8 to 12.

3 METHODS

In mid-March 1996, we selected three fields each of harvested soybean and corn located within 1.6 km of blackbird roosts. We placed one pair of plots of equal size (~1.1 ha) in each field about 50 m apart. One member of each pair was baited with brown rice; the other served as an unbaited reference. In mid-March 1997, we selected four harvested fields of each crop and standardized the size of the plots at 0.8 ha.

We applied 22.7 kg of brown rice once or twice per week using a seed broadcaster mounted on an all-terrain vehicle. The frequency of baiting mimics a potential operational program.⁵ We marked the corners of each plot with colored stakes to assist the observers in delineating plot boundaries. We scanned the paired plots from a blind situated 3 m above ground level and mounted on a pickup truck parked about 25 m from the plots. After a 30-min period of quiet, a single observer recorded the species and numbers of birds using the plots. Observation periods lasted 1 h with 1-min counts alternating on each plot every 5 min (12 observations h^{-1}). All observations were made by a pool of four trained observers. In both years, the study started after the snow had melted and ended when spring cultivation was initiated. Observations were not conducted during periods of snow, rain or wind $>32 \text{ km h}^{-1}$.

In 1996, we observed the paired plots in random order from 21 March to 26 April during four equal time strata. In 1997, we observed paired plots in random order from 29 March to 29 April during two equal time strata. We eliminated the two mid-day time strata in 1997 because bird activity had been comparatively low in these strata during 1996.

4 STATISTICAL ANALYSES

We used mean number of birds per minute of observation during the 168 1-h periods as the measurement unit for analyzing bird activity in the plots. We analyzed count data for individual species occurring in $>10\%$ of the 1-h timed observations. The majority of species were seen infrequently and thus were grouped into the general category of granivorous species. Prior to statistical analysis, the count data for individual species and all granivorous species combined were transformed using the square root to increase normality.¹⁷ Our study was designed as a three-factor (ie Date, Crop, Treatment) experiment with two repeated measures factors (ie Date, Treatment). We used the Proc GLM procedure to examine null hypotheses that the mean numbers of birds were similar between harvested corn and soybean fields, between rice-baited and unbaited plots, and among dates within year.¹⁸ Interactions among treatments (unbaited and baited) date within year (1996 and 1997) and between crops (soybean and corn) also were tested to examine for differences in trends in bird numbers. We set the significance level at 0.10 because (1) resources were not sufficient

to increase sample sizes and (2) the consequences of accepting false null hypotheses (Type II errors) on populations of birds using DRC-1339-baited plots are much greater than if Type I errors (rejecting true null hypotheses) were made.¹⁹

5 RESULTS

5.1 Bird species

We identified 16 species of granivorous non-target birds (Tables 1, 2) in 1996 and 1997. Across both study years, western meadowlarks (17.3%) occurred most often, followed by horned larks (10.4%), American tree sparrows (7.7%), song sparrows (6.0%), vesper sparrows (5.0%), Lapland longspurs (4.8%), mourning doves (2.4%), mallard

ducks (1.8%), ring-necked pheasants (1.8%), Canada geese (1.5%) and American coots (1.5%). The remaining five birds, dark-eyed junco, chipping sparrow, savannah sparrow, gray partridge and snow bunting were recorded during <1% of the observations hours. Dark-eyed junco, chipping sparrow, and snow bunting were recorded in 1996 but not in 1997. Lapland longspur, American coot, Canada goose, vesper sparrow, gray partridge and savannah sparrow were observed in 1997 but not in 1996.

In 1996, we counted 349 granivorous birds during 71 observation hours. Western meadowlarks and American tree sparrows were observed during >10% of the hour observations. In 1997, we recorded 3,326 non-blackbird granivorous birds during 97 h. Western meadowlarks and horned larks were observed during

Table 1. Mean numbers of granivorous birds, excluding blackbirds, present in harvested corn and soybean fields in eastern South Dakota from 21 March to 26 April 1996 and from 29 March to 29 April 1997

Name	1996				1997			
	Corn		Soybean		Corn		Soybean	
	Mean number of birds min ⁻¹ (n = 28 h) ^a (SE)		Mean number of birds min ⁻¹ (n = 43 h) ^a (SE)		Mean number of birds min ⁻¹ (n = 46 h) ^a (SE)		Mean number of birds min ⁻¹ (n = 51 h) ^a (SE)	
Lapland longspur								
<i>Calcarius lapponicus</i> L	0.00	0.000	0.00	0.000	0.00	0.000	1.65	0.955
American tree sparrow								
<i>Spizella arborea</i> (Wilson)	0.08	0.072	0.11	0.064	0.01	0.009	0.03	0.030
American coot								
<i>Fulica americana</i> Gmelin	0.00	0.000	0.00	0.000	0.50	0.439	0.00	0.000
Western meadowlark								
<i>Sturnella neglecta</i> Audubon	0.03	0.015	0.05	0.025	0.02	0.006	0.03	0.010
Song sparrow								
<i>Melospiza melodia</i> (Wilson)	0.04	0.036	<0.01	0.005	<0.01	0.005	0.03	0.019
Canada goose								
<i>Branta canadensis</i> (L)	0.00	0.000	0.00	0.000	0.03	0.019	0.00	0.000
Mallard								
<i>Anas platyrhynchos</i> L	0.00	0.000	0.04	0.034	<0.01	0.007	0.00	0.000
Horned lark								
<i>Eremophila alpestris</i> (L)	0.00	0.000	<0.01	0.006	<0.01	0.005	0.06	0.020
Snow bunting								
<i>Plectrophenax nivalis</i> (L)	0.00	0.000	<0.01	0.004	0.00	0.000	0.00	0.000
Dark-eyed junco								
<i>Junco hyemalis</i> (L)	0.00	0.000	<0.01	0.004	0.00	0.000	0.00	0.000
Chipping sparrow								
<i>Spizella passerina</i> (Bechstein)	0.01	0.000	<0.01	0.004	0.00	0.000	0.00	0.000
Vesper sparrow								
<i>Poecetes gramineus</i> (Gmelin)	0.00	0.000	0.00	0.000	<0.01	0.004	0.04	0.021
Savannah sparrow								
<i>Passerculus sandwichensis</i> (Gmelin)	0.00	0.000	0.00	0.000	0.00	0.000	<0.01	0.002
Ring-necked pheasant								
<i>Phasianus colchicus</i> L	0.01	0.007	0.00	0.000	<0.01	0.006	<0.01	0.006
Gray partridge								
<i>Perdix perdix</i> L	0.00	0.000	0.00	0.000	0.00	0.000	<0.01	0.001
Mourning dove								
<i>Zenaidura macroura</i> (L)	0.00	0.000	<0.01	0.004	0.01	0.012	<0.01	0.001
Unidentified sparrow								
Emberizidae	0.00	0.000	0.00	0.000	0.00	0.000	<0.01	0.001
All granivores	0.15	0.080	0.24	0.082	0.60	0.445	1.85	0.952

^a Plots were observed for 1 min at 12 consecutive 5-min intervals and averaged over the 1-h observation period.

Table 2. Mean numbers of granivorous birds, excluding blackbirds, present in rice-baited and unbaited reference plots placed in fields of soybean in eastern South Dakota from 21 March to 26 April 1996 and from 29 March to 29 April 1997

Name	1996				1997			
	Unbaited reference		Rice baited		Unbaited reference		Rice baited	
	Mean number of birds min ⁻¹ (n = 71 h) ^a (SE)		Mean number of birds min ⁻¹ (n = 71 h) ^a (SE)		Mean number of birds min ⁻¹ (n = 97 h) ^a (SE)		Mean number of birds min ⁻¹ (n = 97 h) ^a (SE)	
Lapland longspur	0.00	0.000	0.00	0.000	0.10	0.060	1.64	0.709
American tree sparrow	0.03	0.020	0.19	0.160	0.02	0.017	0.02	0.015
American coot	0.00	0.000	0.00	0.000	0.10	0.080	0.38	0.285
Canada goose	0.00	0.000	0.00	0.000	0.02	0.012	<0.01	0.009
Western meadowlark	0.02	0.010	0.06	0.021	0.01	0.004	0.04	0.008
Song sparrow	<0.01	0.004	0.01	0.007	0.01	0.006	0.03	0.014
Mallard	0.04	0.027	0.01	0.012	<0.01	0.000	0.00	0.000
Horned lark	<0.01	0.004	<0.01	0.003	0.03	0.013	0.03	0.009
Vesper sparrow	0.00	0.000	0.00	0.000	0.02	0.011	0.02	0.012
Ring-necked pheasant	0.01	0.007	0.00	0.000	<0.01	0.004	<0.01	0.004
Mourning dove	<0.01	0.004	0.00	0.000	0.01	0.008	<0.01	0.002
Dark-eyed junco	0.00	0.000	<0.01	0.003	0.00	0.000	0.00	0.000
Chipping sparrow	<0.01	0.004	0.00	0.000	0.00	0.000	0.00	0.000
Snow bunting	0.00	0.000	<0.01	0.004	0.00	0.000	0.00	0.000
Savannah sparrow	0.00	0.000	0.00	0.000	0.00	0.000	<0.01	0.002
Gray partridge	0.00	0.000	<0.01	<0.001	0.00	0.000	<0.01	<0.001
Unidentified sparrow	0.00	0.000	0.02	0.017	<0.01	<0.001	0.00	0.000
Total	0.12	0.043	0.29	0.071	0.34	0.110	2.17	0.754

^a Plots were observed for 1 min at 12 consecutive 5-min intervals and averaged over the 1-h observation period.

>10% of the observation hours. The increase in bird numbers between 1996 and 1997 was largely due to lingering migratory flocks of Lapland longspurs feeding in soybean fields (Table 2).

5.2 Corn vs soybean

We recorded 11 and 14 granivorous bird species in corn and soybean fields, respectively. Of these species, 9 were common to both crops (Table 1). In 1996 ($X = 0.20$, $SE = 0.042$) and 1997 ($X = 1.24$, $SE = 0.382$), average granivore numbers min⁻¹ were not significantly different among observation dates (P range = 0.120–0.899).

In 1996, numbers of American tree sparrow, western meadowlark and total granivorous birds were similar between harvested fields of corn and soybean (P range = 0.322–0.914), averaging 0.10 birds min⁻¹ ($SE = 0.034$), 0.04 birds min⁻¹ ($SE = 0.012$) and 0.20 birds min⁻¹ ($SE = 0.042$), respectively. There was a marginally significant crop and date interaction for western meadowlarks ($P = 0.092$) because the birds tended to use corn fields in early April and soybean fields in late April.

In 1997, horned larks ($X = 0.03$, $SE = 0.008$), western meadowlarks ($X = 0.02$, $SE = 0.004$), and total granivorous bird ($X = 1.24$, $SE = 0.382$) abundances did not differ between corn and soybean fields (P range = 0.122–0.473). The crop type and date interaction was significant for horned larks ($P < 0.001$) due to high numbers of birds using rice-baited soybean fields in early April, while few used corn fields throughout the study.

5.3 Rice-baited vs unbaited reference

In 1996, total numbers of American tree sparrows, western meadowlarks, and total granivorous birds were significantly different (P range = 0.069–0.087) between rice-baited and unbaited reference plots (Table 2). In 1997, total numbers of horned larks, western meadowlarks, and total granivores did not differ between rice-baited and untreated plots (P range = 0.299–0.494). Interactions between treatment and date were not significant in 1996 (P range = 0.529–0.826) or 1997 (P range = 0.185–0.458).

6 DISCUSSION

We observed 16 granivorous bird species in study plots placed in fields of harvested corn and soybean. Earlier studies found 13 bird species in similarly placed and sized plots in corn fields during 1995,⁹ 1998 and 1999.¹⁰ These researchers recorded four species that we did not record: green-winged teal (*Anas crecca* L.), American widgeon (*A. americana* Gmelin), wood duck (*Aix sponsa* (L.)) and house sparrow (*Passer domesticus* L.). Thus, across five consecutive springs and three separate studies, 20 granivorous bird species were recorded in plots in eastern South Dakota. These species probably represent nearly all birds that would frequent roadside plots from late March to late April.

Our data showed that horned larks preferred harvested soybean fields over harvested corn fields. Castrale²⁰ also found that horned larks selected soybean over corn fields in southeastern Indiana. These results were not surprising because horned

larks are considered open land birds.¹⁶ The gregarious nature, small size and granivorous food habits of horned larks might be reasons for concern. However, the LD₅₀ acute toxicity test for the horned lark showed that these birds are less susceptible to DRC-1339 than are blackbirds.¹²

Western meadowlarks and American tree sparrows seem at greatest risk from spring baiting in eastern South Dakota. A single rice kernel, treated with 0.4 mg DRC-1339, is fatal for both species. Western meadowlarks are at risk because they eat rice²¹ and were seen in our bait plots singly and in pairs throughout the study period. In 1997, American tree sparrows were present in the bait plots in flocks up to 20 birds for about 3 days in early April. However, these birds prefer to eat small weed seeds and waste grains,²² and might select against rice when alternative food is available. Other sparrow species are believed to be less sensitive to DRC-1339.^{12,23}

In our study, granivorous birds generally preferred rice-baited plots to unbaited reference plots, indicating an attraction to rice baits as a food source. Similarly, Smith¹⁰ also found that granivorous birds were attracted to rice. On the other hand, Linz *et al.*⁹ reported comparable numbers of birds in rice-baited and reference plots in corn stubble fields in the same study area that we used in eastern South Dakota. We cannot explain the difference in results among studies. It seems reasonable, however, that some seed-eating birds could be attracted to rice.

7 CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Our data support the contention of Smith¹⁰ and Linz *et al.*⁹ that a spring blackbird baiting program with DRC-1339-treated rice bait presents a potential hazard to granivorous birds. However, both exposure and susceptibility of non-target birds to DRC-1339 must be considered prior to a complete assessment of risk. Exposure depends on feeding ecology, habitat use, abundance, and availability of DRC-1339, putting some avian species more at risk than others. Western meadowlarks and American tree sparrows are the species most at risk in eastern South Dakota because of their food habits, relative numbers and susceptibility to DRC-1339. Other birds could be at risk, if conditioned to visit baited plots. Any planned baiting program would involve using a diluted bait ratio of one treated to 25 untreated rice kernels or greater and <25–0.8-ha plots,⁵ which might reduce non-target exposure.

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